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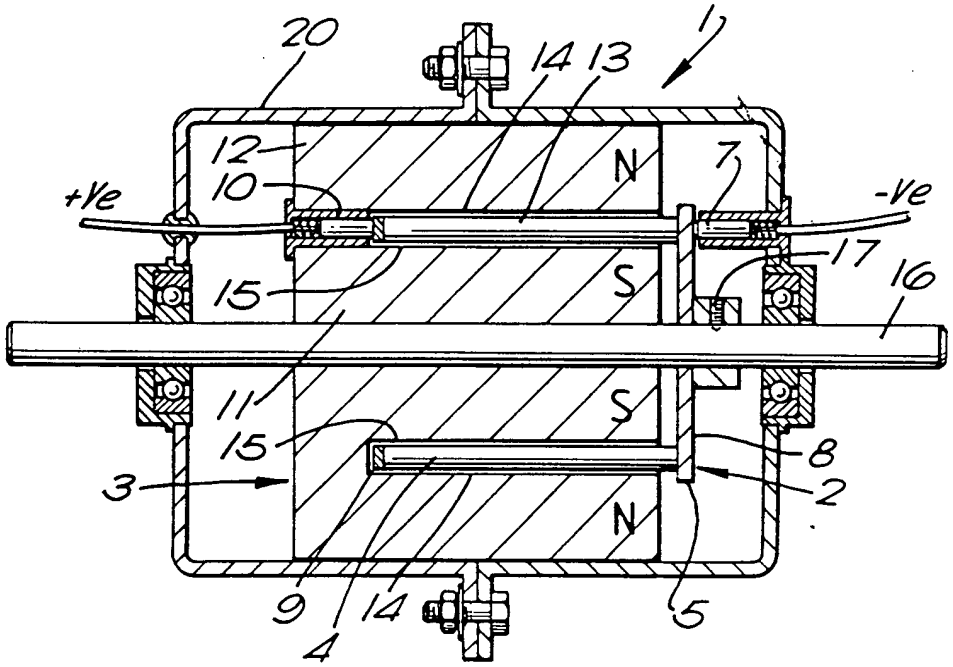
(54) Concentric pole homopolar D.C. electric motor

(57) A concentric pole electric motor comprises a stator 3, with an air gap 13 between inner and outer pole parts 11, 12. The cylindrical surfaces 14, 15 opposing each other across the air gap 13 are of opposite polarity and the whole of each surface 14, 15 is of the same polarity. A rotor 2, comprising a plurality of bars 4 connected between end rings 5, 9 is disposed in the air gap, and the end rings are in conductive contact with terminals 7 and 10 of a dc supply. The rotor is rotationally integral with an axial output shaft 16.

FIG. 1



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIG. 1

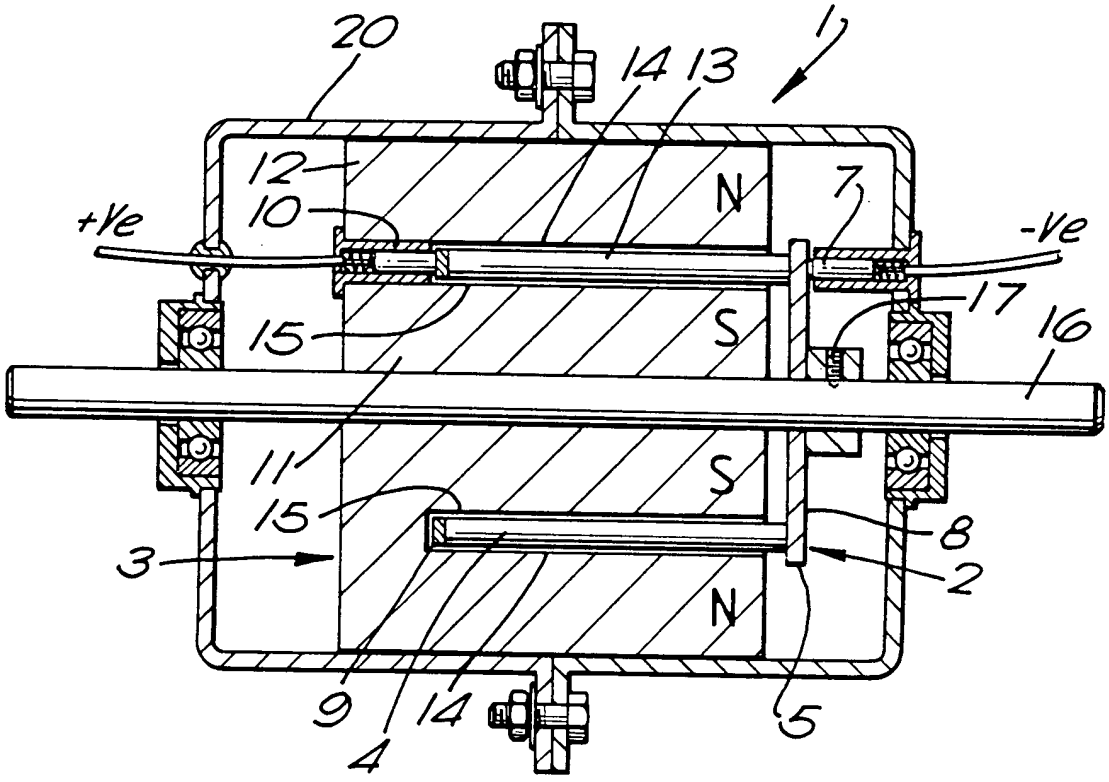


FIG. 2

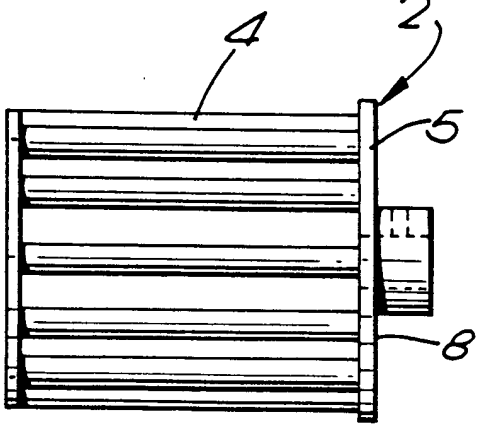


FIG. 3

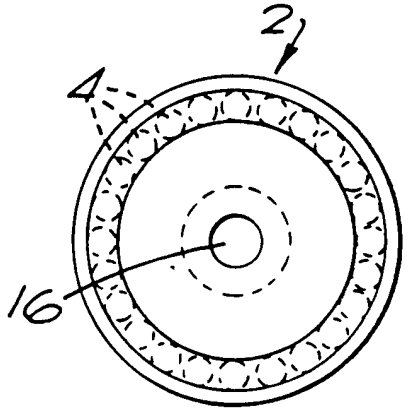


FIG. 4

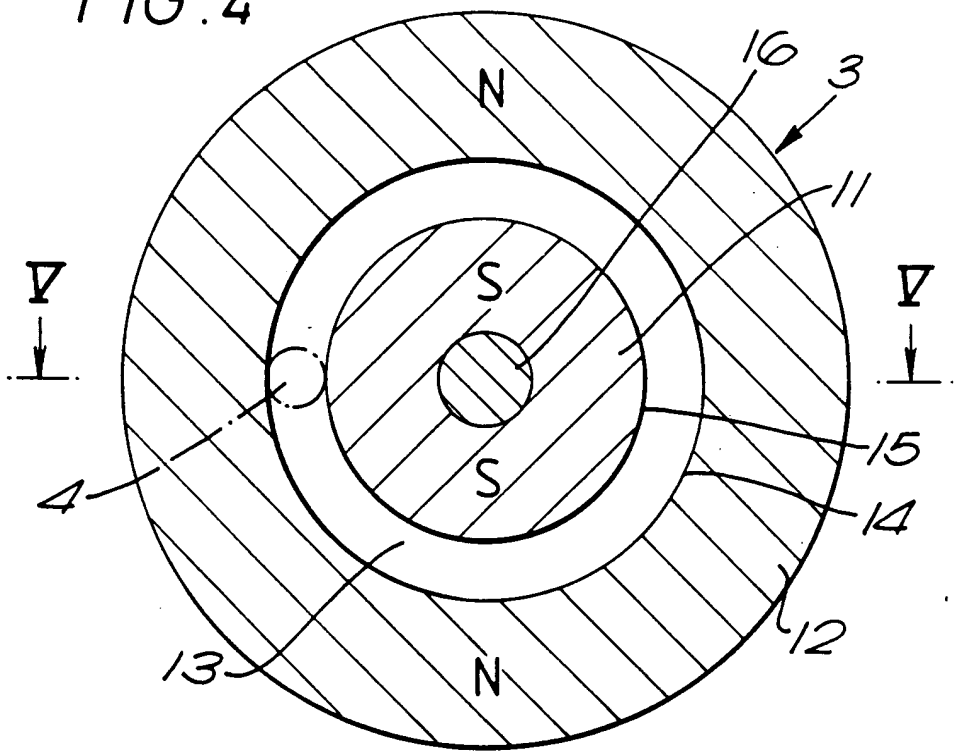
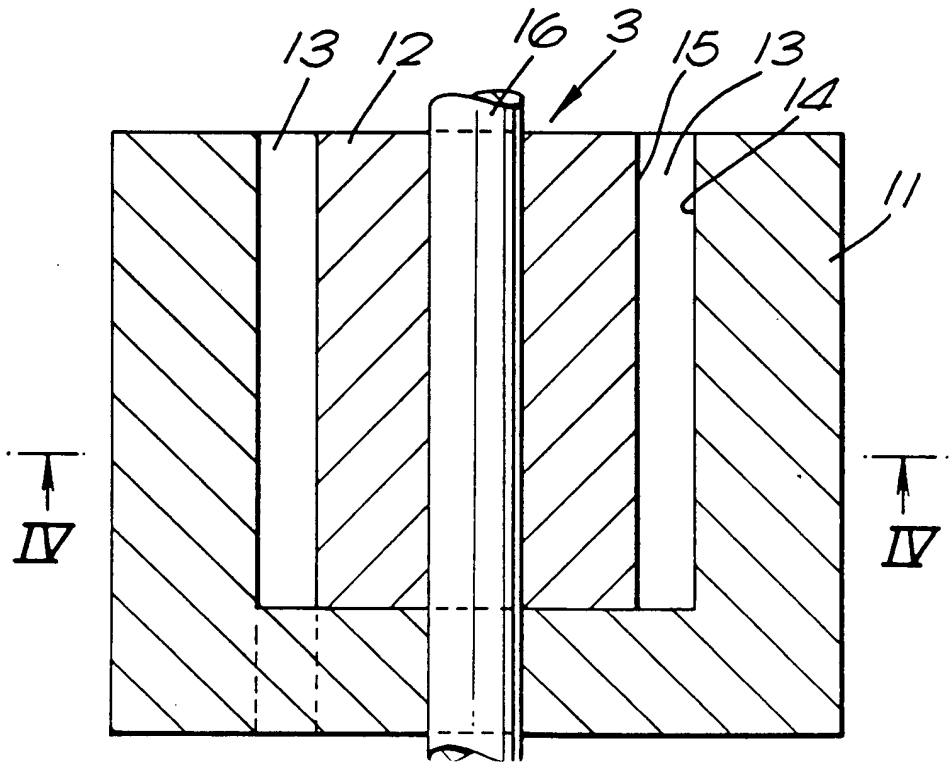


FIG. 5



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Concentric Pole Electric Motor

This invention relates to an electric motor having at least one pair of concentric magnetically-opposed poles.

Known electric motors comprise a rotor armature, disposed to rotate within a stator comprising pairs of radially oposed poles. The armature windings in a d.c. motor have to be reversed in polarity as the pass from within one pole of the stator to the next, which requires the provision of comutators to connect the armature to the correct current polarity in turn. Also, hysteresis losses cause heating of the armature cores and reduce efficiency. Excess heating may also cause distortion of metallic parts, increase friction and lead to jamming.

An object of this invention is to provide a d.c. electric motor of simplified structure which eliminates the need for commutators, and reduces hysteresis losses and over heating, if possible eliminating them.

According to the invention, an electric motor comprises a stator with at least one pair of concentrically - disposed opposite poles, with an air gap therebetween, and a rotor comprising a plurality of electrically conductive members disposed to rotate in the air gap, and electrically energiseable to induce a field which interacts with the field of the stator poles across the air gap to produce rotation of the rotor.

The rotor may be in the form of a cage with a large number of conductive bars. The bars are preferrably connected to an output shaft and electrically connected by end rings of the cage which are in sliding contact with respective d.c. terminals.

More than one pair of concentric poles may be provided, each pair having an associated air gap in which the bars of a cage are accommodated. The rotor may be, in such an embodiment a plurality of concentrically disposed cages connected to the same mechanical output shaft, and with appropriate electrical connections.

The operation of the motor arises from a simple continuous interaction between the field induced about each bar of the cage and the field between the concentric poles of the stator across the air gap. This interaction proceeds without field reversals in the stator or rotor. The lines of force of the stator field extend directly radially between the North and South poles across the air gap. The field induced by the current flowing in each bar rotates either clockwise or ant-clockwise, depending on the direction of the current. The stator field and the respectively induced fields interact to reinforce the field to the side of each bar where the fields have the same direction and are cancelled out to produce a weaker field to the side of each bar where the fields are opposed. This differential in field strength propels the bar from the reinforced field into the attenuated field. The net effect produced is to rotate the cage and thus drive the rotor and associated output shaft in a direction which depends on the direction of the current through the bars, i.e. reversal of the current will reverse the direction of rotation of the rotor. If the upper terminal is positive and the lower negative with the inner pole 'N', the rotor will turn clockwise as seen from above, and vice-versa.

A preferred embodiment of electric motor according to the invention will now be described by way of example, with reference to the accompanying drawings, wherein:-

Fig. 1 is an axial cross-sectional view of an electric motor according to the invention;

Fig. 2 is a perspective view of a rotor cage used in the motor;

Fig. 3 is an end view of the rotor of Fig. 2;

Fig. 4 is a cross-sectional view of the stator used in the motor, on line IV-IV of Fig. 5; and

Fig. 5 is an axial cross-sectional view of the stator of Fig. 4 on line V-V of Fig. 4.

An electric motor 1 according to the invention comprises a rotor 2 and a stator 3 mounted in a motor housing 20. The rotor 2 comprises a cage made up of a plurality of bars 4 of electrically conductive material extending from a ring 5 of conductive material the outer face of which provides an annular contact surface 8 to contact a contact stud 7 in sliding contact with surface 8. The lower ends of the bars 4 are joined by a ring 9 which is in sliding contact with a contact stud of terminal 10. The disc 5 is mounted on a drive shaft 16 and rotationally integral therewith, e.g. by means of screws 17. Shaft 16 projects from both ends of housing 20 to allow a drive connection at either or both ends.

The stator 3 comprises an inner pole part 11 and an outer pole part 12, separated by an annular air gap 13 in which the bars of the cage extend. The magnet assembly is

characterised by the fact that the inner annular surface 14 of the outer pole part 12 is all of the same polarity, and the outer surface 15 of the inner magnet pole part 11 is all of the opposite polarity. When direct current is passed through the bars 4 of the cage between the terminals 8 and 10, the induced fields in the bars interact with the field between the poles of the magnet 11 and 12 opposing each other across the air gap 13, thereby producing rotary movement of the cage as explained above.

The magnet pole parts 11 and 12 may ~~each~~ comprise part of a permanent magnet or an electromagnet wound so as to be energised by direct current to produce opposite poles at their respective inner and outer ends. In this case the sense of rotation of the rotor may be reversed by reversing the current in the electromagnet windings as an alternative to reversing the current through the cage.

Current regulation may be incorporated in the supply to the rotor due to its low resistance and small induced back E.M.F.

To enhance torque, the magnet assembly could be of relatively large diameter, and the central pole be hollow to reduce weight and save material. The rotor could be in the form of a cylinder of conductive film, with insulating strips etched in the side, or gaps etched out.

Claims

1. An electric motor comprising a stator with at least one pair of concentrically disposed, magnetically opposing poles with an air gap therebetween and a rotor comprising a plurality of electrically conductive members disposed to rotate in the air gap and electrically energiseable to induce a field which interacts with the field of the stator poles across the air gap to produce rotation of the rotor.

2. A motor according to Claim 1 wherein the rotor is in the form of a cage with a plurality of conductive bars extending into the air gap between the poles.

3. A motor according to Claim 2 wherein the rotor is mechanically connected to an output shaft.

4. A motor according to Claim 3 wherein the cage has a ring at each end to which the bars are joined, the rings each being in sliding contact with a d.c. terminal.

5. A motor according to any preceding Claim having more than one pair of concenric poles with associated air gaps, in which the bars of respective rotor cages are disposed.

6. A motor according to any preceding Claim having an axial output shaft which passes axially through the motor housing, the rotor, and the stator, and projects at each end for alternative output connection.

7. A electric motor substantially as herein before described, with reference to and as illustrated in the accompanying drawings.

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